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Notes on the development of Tubulina cylindrica and allied species of Myxomycetes.

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That part of the life cycle of the curious and ever interesting Myxomycetes, which includes the formative plasmodium and its subsequent stages of development into mature sporangia, has been the subject of extensive physiological study in the laboratory, but has been as yet but little considered by the systematists.

Notwithstanding the anomalous character of the origin and development of these marvelous organisms, their generic and specific limits are practically well defined and apparently as stable as in any other natural group. This is essentially true, even though the sporangia of the mature Myxomycetes manifest a well marked tendency to variation of form, color and structure which seems to characterize some genera especially, while only exceptionally found in others.

Excessive as this variation is in some cases, it may be found by careful field work or by an analysis of a large number of specimens to fall within specific lines, and to be due mainly to local external influences.

Many causes operate to produce these results in the mature sporangia, the most active being the varying or extreme degrees of temperature and atmospheric moisture to which they are exposed. During a period of several days of great warmth combined with great humidity, the plasmodium will develop rapidly and multiply with wonderful exuberance, causing the resulting sporangia to lose their possibly simple normal character and become clustered, distorted or plasmodiocarpous in form. Climate, the season of the year, or what may have practically the same effect, the altitude of habitat, will cause a difference in the time of development from plasmodium to maturity, of from twenty-four hours in some cases to nearly a week in others, with a corresponding difference in results.

As a familiar example of this, Hemiarcyria clavata developed in the hot days of July and August will erect quickly into scattered, globose, long-stiped sporangia which rupture

immediately as they dry, leaving scarcely a vestige of a receptacle, while the same species late in October will develop closely aggregated, obovate, almost clavate sporangia, nearly sessile or with quite short stipes, which rupture slowly several days after maturity, leaving a very deep funnel-shaped receptacle.

Among the Calcareæ, the amount of lime in solution available for the use of the plasmodium will greatly influence the degree to which lime granules are found in the capillitium and sporangium walls, thus producing great apparent variation in structure. Careful examination in these cases, however, will show that the essentials of structure are the same, and the amount of lime only a variable and non-important factor.

In the plasmodial stage of the Myxomycetes, however, no such tendency to variation exists, and the plasmodium of every species which I have observed is unvarying in color and other physical characters. It is true, the normal color may be temporarily affected by adventitious coloring matter picked up by the plasmodium during its amœboid wanderings and absorbed into its mass, but these particles are soon excreted or deposited, and have no permanent influence.

To cite a few of the familiar and better-known species out of many which could be given: Fuligo varians always develops from a rich yellow plasmodium, Dictydium cernuum from a purple-black, Leocarpus fragilis from a reddish orange, Chondrioderma floriforme from a gray or drab, the Arcyrias and many others from an uncolored or white plasmodium, and so on without any exception that I have noted.

The question of the constancy of the color changes in the stage following the plasmodial, that of the differentiation and development of sporangia, is more difficult of determination, because it is a progressive stage, one of variable duration, and one susceptible to external influences. Nevertheless, I believe it to be equally true that the color of the corresponding stages of development of the individual sporangia, from plasmodium to maturity, is always the same, varying only in duration and intensity according to local conditions.

If this view be strengthened by further observations, it can not be doubted that a knowledge of the color and character of the plasmodium, and of the color changes in the transitional period from the plasmodic to the mature stages of the Myxomycetes, is of diagnostic value, and may, under certain conditions, be essential to the correct determination of species and their relations to each other.

The following observations upon *Tubulina cylindrica* (Bull.) and allied species are given as a contribution to their life histories, with special reference to the points above noted:

Tubulina cylindrica, as found in the eastern part of the United States, varies greatly in external appearance. By a careful examination all mature specimens, including unusual forms or variations, found in this area, may be separated into two groups by their external differences only. These differences, however, relate only to such characters as density and color, which, in the mature sporangia, have no essential value as points of specific difference, the sporangia of the two groups being morphologically the same.

During the summer of 1889, while in the Adirondack mountains, N. Y., I had the opportunity of observing the development of typical examples of each of these forms from the plasmodium through all the intermediate stages of growth to maturity, under similar local conditions. I had previously noted developmental differences, but on the present occasion the forms under comparison grew simultaneously on adjoining logs, thus having the same relative conditions of temperature, atmospheric humidity and moisture of subjacent log surface to influence their growth. Both forms originated from a white or uncolored plasmodium, but from this point the corresponding stages of differentiation and erection of the respective sporangia to complete development and maturity were notably different in color and character.

The contrasting external character of mature specimens of these types may be described as follows:

Form no. 1 is composed of an aggregation of cylindrical sporangia, sessile, standing on a common hypothallus, individual sporangia either free or united wholly or in part by their walls, apices rounded or conical, very fragile in structure, breaking at the slightest touch, light brown or chestnut brown in color. This is the type of the common *Tubulina cylindrica* (Bull.) and is found probably in all parts of the United States.

Form no. 2 is an æthalium composed of an aggregation of cylindrical sporangia becoming many-sided by mutual pressure, sessile, standing on a common hypothallus, always (or with rare exceptions) united the entire length of the sporangia, the apices flattened, making in continuation a nearly plane and vernicose surface of considerable density of structure, dark brown or umber in color. The entire structure of the sporangia of this form is markedly denser and darker than in the other. I have as yet found it only in the

mountain regions of New York or Pennsylvania. The spores in both forms are practically the same, the only difference being due to the thicker and darker epispores of form no. 2. The epispores are similarly sculptured, showing characteristic irregularly meshed reticulations under a high power.

The differential stages of development of the two forms from the plasmodium, showing the color changes, may also be tabulated as follows:

Form no. 1 originates in an uncolored or white plasmodium, erects into bright rose or strawberry red immature sporangia, and then shades into the light-brown or chestnut-brown color of maturity.

Form no. 2 originates in an uncolored or white plasmodium, erects into dark raspberry or mulberry red immature sporangia and then shades into the dark brown or umber color of maturity.

These comparative differences in color appeared in all cases which I have had the opportunity of observing. In individuals of the same type the color varies only in intensity or brightness, not in tone, according to the degree of moisture present in the atmosphere or in the substratum. An excess of moisture, such as may be caused for instance by heavy rains falling upon the immature sporangia of any of the Myxomycetes, will render them dull and lifeless in color, imparting a faded or washed-out appearance.

A correct appreciation of color distinctions depends so largely upon the personal equation of the observer that I feel conscious that the foregoing changes may not have been sufficiently described, but the point desired to be specially noted, is that each of the above forms, and those yet to be described, has a distinct series of color changes which characterizes its immature period of growth. The differences in development just noted would be better appreciated if seen than described, and, considered in connection with the conspicuously different external appearance of the two forms, will justify the belief of a physiological specific distinction between them. At the same time these forms are morphologically similar, and as sufficient herbarium characters available for classification in separate species are lacking, they will probably still be referred to the same species by systematists.

It seems fitting that the developmental history of the following species, allied to Tubulina cylindrica, should also be recorded with it:

Tubulina stipitata B. & C. This species originates from

an uncolored or white plasmodium, erects into salmon or buff colored immature sporangia, and then shades into the chestnut umber color of maturity.

This species is not always stipitate, although it was so described by Berkeley. Sessile specimens are not uncommon, and in many instances they are found associated with others which are stipitate or sub-stipitate, all having the same small, characteristic spores.

Siphoptychium Casparyi Rostfki. This species originates from an uncolored or white plasmodium, erecting into immature sporangia of a dull gray, tinged with sienna color, and then shades through various tones of sienna brown to the dark brown or umber of maturity.

A large æthalium of this species approaching maturity suggests a curious and striking similarity in color to a beautifully browned roll or loaf of bread, and as it generally grows upon the surface of a moss-covered log, it makes a conspicuous object.

Although the necessities of a systematic arrangement apparently led Rostafinski to place the genus Siphoptychium in his order Columelliferæ, it undoubtedly bears a closer relation to the genus Tubulina than to any other, and should be classified with it or near it. The spores are of the characteristic Tubulina type, with the epispores sculptured with an irregularly meshed reticulation. The sporangia much resemble externally those of Tubulina cylindrica (form no. 2), but differ from them in being provided with a central tubular columella from which radiate a few threads or tubules, like stays connecting it with the walls of the sporangia. By a careful examination it may be seen that these columellas and radial tubules are apparently the remains of individual sporangia aborted in the course of the evolution of the genus, and are not of the same character as the columellas and threads of other members of the Columelliferæ. In partial corroboration of this view, may be cited the fact that æthalia of Siphoptychium are found, in which from one-third to one-half of the component sporangia lack both columellas and connecting threads, resembling so far the genus Tubulina.

Moreover, I have in my possession a specimen of Tubulina cylindrica (form no. 1), in which can be seen a number of sporangia which have either vertical membranous septa or threads crossing from side to side. There are also a few contracted or aborted sporangia which serve as columellas, in the center of larger ones, to which they are united with

threads or tubules, indicating an evolutionary approach toward the genus Siphoptychium.

For these structural reasons, and also by reason of analogous development, the genus Siphoptychium, notwithstanding its present position in the classification of its author, has been treated in this paper as allied to the genus Tubulina.

Philadelphia.

Notes upon Peronosporeæ for 1890.

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The season just closing has been a moderately wet one in New Jersey, but the excess of rainfall did not equal that of last year. This statement that we have had two succeeding wet years is an important one in this connection. All of the ordinary forms of the order Peronosporeæ have been abundant, and only a word will be said of a few of the leading species, as there are a number of new hosts for old forms and some species new to America to be herein recorded.

Phytophthora infestans D'By., causing the wet rot of the white potatoes, has been most strikingly destructive this autumn, especially in the southern counties of the state. So abundant has it been that thousands of acres that otherwise would have yielded a large crop will not be dug at all. Slices of the rotting potatoes placed in moist chambers developed the conidiophores and spores in four hours. This gives some idea of the rapidity with which this fungus runs its course, always a surprise as well as source of dismay to the growers.

The *Phytophthora Phaseoli* Thax., first found last season by Dr. Thaxter in Connecticut, has been frequently looked for but not obtained upon any sort of cultivated bean. This new member of the small genus may as yet be quite local in its range, but is expected in sight at any time.

Plasmopara viticola (B. & C.) Ber. & DeT., has been abundant upon the grape. In one vineyard where hundreds of clusters had been ruined by this mildew, after a long search none could be found upon the leaves. This is so unusual that it is worthy of notice. In this connection it may be said that specimens of succulent galls of the stem and leaf-stalks were sometimes found completely covered with the Plasmopara, while other parts were entirely free. This indicates that the soft gall tissue furnishes better conditions

for the growth of the mildew than the ordinary stem or leaf. The same mildew has been common upon the Ampelopsis tricuspidata, causing the portions of the attached leaves to turn a rich red upon the upper side as if prematurely ripening. While at Liberty, New York, the Plasmopara was found in abundance upon a cultivated plant of Ampelopsis quinquefolia growing upon a trellis with no grape vines or other Virginia creeper plants within a long distance. No signs of the mildew were upon the fruit. A few plants growing upon the ground in a wood lot at Cold Spring Harbor, Long Island, had nearly every leaf attacked, and here as noted for the A. tricuspidata the foliage had turned in early July to a beautiful rich red color. The coloration was so strong and constant that it served as a guide in collecting specimens.

Abundant specimens of *Plasmopara entospora* Schrœt. were found in early May upon Erigeron Canadense, which was the first time the writer had succeeded in taking this peculiar and abbreviated species.

Plasmopara Geranii (Pk.) Berl. is becoming the most common species in the vicinity of New Brunswick, especially upon the Geranium Carolinianum, which it covers in early spring. It establishes itself upon the seedlings of this winter annual in late autumn. No oöspores seem to form in this host and there is no particular reason for their presence as the mildew passes the winter in the tissue of the host which is better than in the form of oöspores.

Bremia Lactucæ Regel (Peronospora gangliformis D'By.) was abundant upon Lactuca Canadensis in some parts of the state, and weakened materially the vigor if not shortened the life of this weed. However, in the greenhouses it worked some damage to the lettuce crop during the winter months.

Peronospora parasitica D'By. has a list of a score of hosts all in the same order (Cruciferæ). It was found in early spring particularly abundant upon Cardamine hirsuta and C. laciniata. On May 17th, it was met with upon the leaves of Hesperis matronalis and several times afterwards upon the same host, which as far as determined is a new one to America. In like manner on June 4th it was taken upon many of the outer leaves of the common cabbage. No mention of this host is made by American writers upon the order.

Peronospora Violæ D'By. did not prove so destructive to the cultivated violets as was feared last winter, and diseased plants from several greenhouses fail now to confirm

any suspicions that the prevailing trouble is due to a Peronospora. It is only fair to give the Peronosporas in particular, and as a whole, their dues.

In this connection it may also be noted that while last year there was a fair abundance of the rare *Peronospora Cubensis* B. & C., that ruined the crops of hot-house cucumbers in this locality and was found upon field-squash, pumpkins and cucumbers generally, during the present season it has almost failed to appear. This is a surprising fact, for with the wet season it was predicted that this Peronospora would be widespread. No oöspores have yet been found and their absence in a species that preys upon short-lived annuals in our climate may help to explain the coming and going of this shy mildew.

Peronospora effusa Rabenh. was to be found quite generally upon the cultivated spinach, but it was not the cause of the most serious of the fungous troubles of that crop.

Peronospora Ficariæ Tul., which is recorded upon several crowfoots, was met with May 6th abundant upon an apparently new host, namely, Ranunculus abortivus and with oöspores.

Peronospora alta Fl. heretofore has only been recorded upon Plantago major and P. lanceolata. During May and June it was unusually abundant upon Plantago Virginica, causing the plants to become dwarfed and turn of a sickly yellow. Oöspores were present.

A Peronospora new to this country is *P. obovata* Bonord, found upon Spergula arvensis at Liberty, N. Y. Unlike most members of the genus, this prefers the stem of the host, and appearing in patches of an inch or less in length, it often weakens the stem so much as to cause it to bend. In like manner it often appears upon a few of the peduncles of the loose inflorescence, causing the infested portions to thicken and remain shorter than the normal ones. On account of this habit it is easy to detect the presence of the mildew. Another sign of the Peronospora is quite constant upon all old infested spots; it consists in the development of a black mould (*Macrosporium parasiticum* Thüm.), which appears nowhere else upon the host, and seems to be strictly parasitic upon the mildew. This matter will receive further attention as time affords an opportunity. The species is particularly well named, as the conidia are distinctly obovate. The oöspores are much like those of other species and not characteristic of this one. It may be said in passing that with the Peronospora there is usually upon the same host

an abundance of *Puccinia Spurgulæ* DC., a species of rust not before recorded in this country. The host, a European plant, is as yet only locally known as a pestiferous weed, and thus there are at least two active fungi which probably came with it from abroad, and we trust will tend to check its spread in America.

Perhaps the most interesting of the peronosporaceous finds during the year has been that of *Peronospora Rubi* Rabenh., seen first on May 27th sparingly upon Rubus occidentalis in a garden near New Brunswick, and afterwards (July 10th–20th) in abundance upon Rubus villosus var. humifusus at Cold Springs Harbor, Long Island. Upon the downy under surface of the black-cap leaves the Peronospora is not conspicuous, in fact, the species was found by accident while searching with the microscope for the cause of a peculiar curling and browning of the leaves. In appearance, on the other hand, the attacked foliage of the R. villosus is quite striking, having a rich red discoloration of the upper surface, as if ripening, a fact that has been mentioned above for P. viticola upon the leaves of the two Ampelopsis hosts.

The Peronospora obovata we can welcome, as it preys upon a weed, but with the species upon the genus Rubus it must be otherwise. As yet we have not suffered from it, but only recall the nature of the close kin of this mildew and bear in mind the fact that all the genus Rubus are so nearly related that when one is attacked by rust or anthracnose, all are liable to suffer, and it becomes evident that in Peronospora Rubi we may have a serious enemy to our blackberries, raspberries and blackcaps that could add a heavy load to the already great burden of plant diseases that the small fruit grower is forced to bear. It is in such cases as this that a law for the destruction of fungi could be operative and effective. It may be that the Rubus Peronospora is only to be found in a few places, and therefore could be exterminated at little expense. But when once it has spread through the fruit gardens it will be an enemy demanding attention like the one upon the grape.

Of the genus Cystopus only a brief note is called for here. Until very recently the oöspores of *Cystopus Ipomœæ-panduratæ* Farl. have been looked for in vain. As Dr. Farlow predicted, they were found in the stem of the host. During the present summer, while in the field studying the diseases of the sweet potato, this white mould was found abundant upon the leaves, but in no case were the oöspores met with upon this host. In adjoining fields of corn, however, large quan-

tities of Ipomœa pandurata were found with all parts distorted almost out of recognition with galls in which the oöspores made up the greater part of the swollen masses.

Mycologists and others are welcome to specimens of the various species mentioned in these notes.

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Notes on the flora of the Lake Superior region. IV.

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At Tower I found my first specimen of Geum macrophyllum. It is by no means common in our region. Wheeler and Smith say of it for Michigan: "Rare or not at all in the Lower Peninsula." Upham states that it is abundant north of Lake Superior, where Agassiz also gives it in his work on Lake Superior. It has been found by Dr. Vasey in northern Illinois.

Pretty forms of Circæa alpina were seen in its characteristic localities. The flowers were tinged with red. The pedicels of the flowers and the rachis of the raceme were thickly covered with glandular hairs. Reddish flowers are known to occur in this species, and it seems to approach in this respect its congener, C. Lutetiana.

In the wet grassy grounds, and open grassy woods, was obtained a somewhat unusual form of Campanula aparinoides. It first attracted attention by the color of the flowers and their large size for the species. All were bluish-white, changing to a decided blue on drying. Plants seen about Chicago are nearly always white, though some are tinged or faintly striped with blue, and also become more deeply colored as they dry. The corolla of the Minnesota specimens was from three to four times the length of the calyx lobes. The stems were of ordinary height, but freely branched in a paniculate manner. Nor are the stems of the plants found in this vicinity simple, as they are described in many of our books; they are really branched, and bear a single flower at the end of each leafy branch that is from two to six inches long. This ends in a slender peduncle, but it is provided with leaves like those of the main stem, diminishing in size as the flower is approached. But the branches do not often divide, and the stem is racemosely branched. Wood is more accurate in the description of the plants as I find them, since he characterizes the stems as "branched above." In the

specimens from Minnesota the ultimate branches bear terminal flowers, as is the case with those found here. The base of the corolla, as well as that of the filament, is copiously supplied with long hairs, somewhat reflexed in the Minnesota plants, though they are commonly horizontal. I do not find these hairs mentioned in our descriptive botanies, nor in the Synoptical Flora, although they do mention the hairy style and its adaptation to the collection of pollen. Mention is also made of the dilated bases of the filaments. Yet the hairs are a noteworthy feature and have been frequently referred to, especially in connection with the structure of the flowers for cross fertilization. They project from the margins of filaments, interlocking and closing the free spaces remaining between the bases of the filaments, or "triangular valves," as they are called by Sprengel and Hermann Müller. This is rather from their shape in C. rotundifolia and other European species, for in C. aparinoides they can hardly be called triangular, but only a little dilated. They were called scales by Linnæus[1] or his pupil, Hall, and were mistaken for nectaries, surrounding the base of the style, each bearing a filament at its top.

In the clearings and newly cultivated fields Physalis grandiflora attracts the eye with its large flowers of the purest white. They sometimes measured more than two inches across. The corolla is shallow, saucer-shaped, its border nearly entire. It is a plant worthy of cultivation as an annual, though it has one disadvantage, the flowers not being so prominent as their large size would suggest, being somewhat obscured by the large overshadowing leaves.

Spiranthes gracilis was frequent on some of the moist hillsides, partly covered with shrubs and seedling trees, in the partial shade of which it grew. It had one peculiarity a little singular to my experience with the plant in flower, since nearly all the plants had a tuft of fresh radical leaves, five or six in number. As generally found, it is necessary to look over several individuals to find an occasional specimen with a radical leaf or two in this condition at the time of flowering. I once met with it in this state of growth near Whiting, Ind., but the leaves were not so many, though nearly every plant bore some which were fresh.

Several kinds of Potamogeton were obtained in Vermilion Lake and its affluents. In the lake P. perfoliatus, var. lanceolatus, was one of the most common. P. pectinatus was seen

[1]The Nectaries of Flowers, Fundamenta botanica, Tome I, p. 276.

less frequently. *P. heterophyllus* Schreb., or what seems to be that, the plant being of very large size, was plentiful in some places, evidently the *P. gramineus* Fries., var. *maximus* Morong, found there also by the botanists of the Minnesota Survey in 1886. There are characters which ally it to P. Zizii, and it appears to be intermediate in its characteristics. It approaches in size P. lucens, the stem often being five or six feet long when the water is deep. They are also very branching above, and with leaves exceedingly numerous. They are all very large for P. heterophyllus, except some of the floating ones, which are also large in some specimens, and with long slender petioles when floating. The submerged leaves are rather thin in texture, tapering below, as is usual in the species, the uppermost lacking the coriaceous and shining look of those usually found on stems of P. Zizii and sometimes P. lucens. The fruit is also uncommonly large and when mature more rugose than in P. heterophyllus, which is generally smooth. It is also more inclined to have a keel, as in P. lucens. The fruiting spikes are an inch and a half to two inches long, the ripened fruit somewhat scattered. In typical P. heterophyllus the spikes are commonly about an inch long, cylindrical and densely fruited, while in P. Zizii and P. lucens they are more as in these specimens, long and with fruits more lax. The var. maximus not being recognized even as a synonym in the Revised Manual, there is some doubt where to place these plants, since they are at quite a remove from the typical species, and so marked as to deserve some distinction. I have nowhere seen such large specimens of this species, though finding some with long slender stems, with few leaves, in the small lakes in western New York. The var. graminifolia often has an elongated stem, but not branching as in this case. They also show that there are links, quite closely connecting P. heterophyllus and P. Zizii, and not very remotely P. lucens, though placed in a different section. This is also apparent by the shifting of P. gramineus, var. (?) spathulæformis, over to P. Zizii, and the making of *P. lucens*, var. *minor* Nolte, a synonym of the same species. And I have also found in the shallow ponds of this vicinity P. lucens with green emersed leaves, a condition that may to some degree be accidental by the lessening of the depth of water where they grow in the drier seasons, though proximity to Lake Michigan prevents it falling beyond a certain stage, the water being maintained at the level of the lake by seeping through the sand, or even rising and falling with the winds as they drive the waves to

or from the shores. In such cases the uppermost leaves are green and rest upon the water, the immersed ones shining, all usually coriaceous and with short petioles.

P. pusillus was detected in pools, and in East Two Rivers the related species *P. mucronatus* Schrad. P. Pennsylvanicus was common, some specimens of which, taken from West Two Rivers, had the immersed leaves 7-nerved, the 5-nerved being the usual kind. In the same stream P. rufescens was frequent, and the species rather rare at the west, *P. obtusifolius* Mert. & Koch. It was the first time I had met with it in its place of growth. The stems were quite robust, from two to three feet long; the leaves very uniform in length, or about three inches, acute or acutish, giving it the appearance of small-leaved forms of *P. zosteræfolius* Schum. It was fruiting abundantly, maturing from 12 to 22 nutlets in oblong capitate spikes, half an inch in length, on peduncles fully three times as long. These peduncles, long as compared with the length of the head, I have noticed in specimens from the east by exchange, and the descriptions err by limiting them to about the length of the head. This is as far west as it seems to have been reported in our limits, unless recently found, though found about as far north, in Gratiot Lake, Keeweenaw Peninsula. Prof. J. C. Arthur had previously found it, with most of those already mentioned, in the same locality as seen by his "Report on botanical work in Minnesota for the year 1886."[2]

Another aquatic is worthy of mention, a form of *Sagittaria variabilis* Engel., with floating leaves, found in the same stream. Prof. Arthur also collected it from this locality. It does not seem to be mentioned in the text-books, or in the botanical works of Engelmann, though he gives a variety fluitans for S. heterophylla and S. calycina. In appearance it is considerably different from the common kind, but hardly varies from the type except in this respect: the anthers are about the length of the filaments, rather broadly oblong; bracts 3 to 4; lower whorls of flowers sometimes dicœcious; leaves sagittate, resting on the water, the round, slender petioles too weak to stand erect when removed from the water, to whose depth they correspond in length, those at Tower being from 2½ to 3 feet. The scapes are also slender, but support the flowers and fruit above the water. I have occasionally seen it in other places, as about Chicago, but not in flower or fruit. It was not uncommon in the stream. It may deserve the varietal distinction fluitans, unless it has had

[2] Geological and Natural History Survey of Minnesota, Bulletin No. 3, St. Paul, 1887.

some other designation, for I have met with it often enough to look upon it as constant.

There was one feature of the flowers of this region deserving recognition, as it especially attracted my attention. It was the brightness of their coloration in hues belonging to the red and blue series. This was not noticeable in the yellow series, though it may have been because the shades of yellow are not so varied or striking. There was also a tendency in white flowers to become pink, or show some tinge of color, of which examples have been given. The familiar reds, pinks and purples of the flowers at home were more deeply shaded, and so of the blues and violets, or any intermediate hues. Though inclined to ascribe this to a northerly latitude, since it is known to be the case with plants in mountain regions and high latitudes in Europe, as in the Swiss Alps and Scandinavian Peninsula, it may not be safe to do this from the experience of a single season or the observations of a few days. It did not attract attention in the plants of the Saguenay observed the year before, nor was it noticeable along the south shore of Lake Superior. But the Saguenay country is rather rainy or foggy, and differs in this respect from the drier air and brighter sunlight of Minnesota, with sufficient moisture to keep plants in healthy conditions of growth, but under clearer skies. And I have experienced more of cloudy weather along the southern shore of Lake Superior, though essentially in the same latitude; and there is apparently more moisture in the air and a lessened brightness of the sunlight, the winds from the lake, as they come across it, bringing with them clouds if not rain.

Experiments and observations in regard to the coloration of flowers and the causes of their variability have led to somewhat varied or even contradictory conclusions, but they may throw some light on what was observed in this case. Hildebrand has considered the question in a treatise on the colors of flowers.[3] As direct causes of the formation of different colors, climatic relations, or the influence of light and temperature, are mainly considered. And it is these relations as they bear on the formation of colors other than green which form the subject matter. From the observations and experiments of Sachs and Askenasy the influence of light in the formation of these colors was seen to be very variable, with

[3] Die Farben der Blüten in ihren jetzigen Variation und früheren Entwickelung, von Dr. Friedrich Hildebrand, Leipzig, 1879. The conclusions as they relate to our subject are mainly embodied in pp. 47-57, where experiments of Sachs and Askenasy are discussed, and from which the references to their investigations are chiefly taken.

the exception of yellow, which was constant under the different conditions of experimentation. The experiments were more with plants in the contrasted conditions of light and darkness than in different degrees of intensity of light, though the latter was also considered. Sachs concluded that when other conditions of growth are normal, light has little to do with the formation of the colors of flowers. He says: "As long as sufficient quantities of assimilated materials have been previously accumulated, or are produced by green leaves exposed to light, flowers are developed even in continuous deep darkness which are of normal size, form and color.[4] Hildebrand remarks to the same effect, that the influence of light is intimately associated with the nourishment of the flower by stored up food, as seen in the case of bulbous plants, and the experiments of Askenasy with flowers developed on branches severed from the parent stock, which were sometimes of normal color. "From these few examples," he continues, "we see that light exerts an exceedingly varied influence on the formation of the blue and red colors in different plants, but whether this influence would be shown in the same way under all conditions among similar plants must be held in doubt."[5] His final conclusion is that in order to develop definite colors plants are inherently disposed to receive this influence, some for the development of one color, others for another; some plants in one definite direction, others in another, while in still others the susceptibility to vary may lead them in one direction as well as another, its usefulness to the plant determining what line of color-variation will be taken and ultimately fixed.[6]

De Lanessan devotes some attention to this question in an article in Baillon's "Dictionaire de Botanique,"[7] referring to Askenasy as well as to others that light has a direct influence on the formation of colors in plants besides the green. The few cases which seem to disprove this, of normal colors produced in darkness, he thinks may be traced to other causes; that light may be present the moment they are formed, and that experiments to prove that colors may be developed in darkness should not be confined to a single generation, but should show that they are capable of transmission.[8] Under such conditions he is of the opinion that the colors would at length disappear. He agrees with the idea that it is the usefulness to the plant which determines their colors, although—

[4] Text-Book of Botany, p. 754. Lehrbuch der Botanik, p. 725.
[5] l. c. p. 51. [6] l. c. p. 52.
[7] Coloration et matières colorantes des plantes, l. c. II, 152.

citing Wallace in this connection—it may not be due to the intensity of the light and heat.

On the other hand we have the experiments of H. C. Sorby, summarized by Vines in his edition of Sach's Text-Book, which go to show that the intensity of light has an important bearing on the case. According to Sorby, "Exposure to a greater or less degree of light may produce a great quantitative as well as qualitative difference in the coloring matters."[9] And in regard to the experiments of Sachs, that flowers developed in darkness are colored in much the same way as those developed in the light, Vines remarks: "Askenasy has, however, found that this is by no means always the case, but that the coloration of flowers is in many cases much modified or even absent when the plants bearing them are kept in darkness. There are not at present sufficient data upon which to base an explanation of the diversity of behavior of flowers in this respect, but it appears to depend upon their particular hue. Sorby has observed that the red coloring matter of flowers (which is probably identical with erythrophyll) is formed in smaller quantity in relatively weak than in relatively strong light."[10]

These experiments of Askenasy, and to some extent of Sachs (here taken from Hildebrand's account of them), were to the effect that though in the flowers of Tulipa Gesneriana (a bulbous plant), the red color of the cell contents is formed just as well in entire darkness as in the light, a smaller amount of it was made in the flowers of Tropæolum majus, Cheiranthus Cheiri, Phaseolus multiflorus and Antirrhinum majus. And according to Askenasy almost no production of color at all occurred in the dark in the flowers of Silene pendula; and in the flowers of Orchis ustulata he found that the lower lip had its ordinary color, while the upper lip was pure white, and sometimes the entire flowers. Other flowers showed a paler color under a less degree of light. Hildebrand also mentions what is so often evident, especially in the case of fruits exposed to the sun, that the red color is formed more on one side than on the other. He continues, "So we find that many plants of the plain, if they ascend to where they receive a brighter illumination, which is found on mountains, are colored red, as for example Achillæa Millefolium,

[8] Since light is necessary for the discernment of colors, the celerity with which it acts chemically in some cases may introduce an element of doubt, that what is seen by means of light may have been effected in the dark, though the probabilities are that the colors were so produced.

[9] Text-Book of Botany, p. 767.

[10] Physiology of Plants, p. 267.

while others in this stronger light retain their pure white color."[11] And in a foot note in this connection he cites Hoffman as authority for a change of color in the flowers of valerian (Baldrien in German) from flesh color in Germany to dark-red in Norway.

It seems very probable, therefore, notwithstanding this diversity of views, that bright skies and a continued strong illumination, whether regional or seasonal, may have the influence which was marked enough to be observed in Minnesota, a conclusion reached before making special inquiry to see if it accorded with facts observed by others. And while the inquiry has not in every way proved satisfactory, there yet is left a strong residuum of belief that the cause originally assigned is not without a basis for its support. So, in the experiments it was seen that the yellow colors were but little affected by varied conditions of light, as was the case in the flowers of the Minnesota plants. The subject offers an inviting field of inquiry to those who may be located so as to observe the plants of the northwest in this respect for a sufficient time, and thus reach a more trustworthy conclusion based on a longer series of observations.

Englewood P. O., Chicago, Ill.

Notes on some phanerogams of Central Minnesota.

CONWAY MACMILLAN.

The following is a partial record of observations made during August, 1890, by the writer, who, in company with Mr. E. P. Sheldon, of the University of Minnesota, studied the flora about Gull lake, Cass Co., and in the immediate vicinity of Brainerd, Crow Wing Co., Minn.

Brasenia peltata Pursh.—This plant is occasionally found in the northern part of the state, extending southward to Minneapolis, but is always rare or local. It grows luxuriantly in Irving Chase lake, twelve miles west of Gull lake, and, in a dozen other small forest lakes of the immediate neighborhood, is the most prominent plant. Apparently it excludes from these waters the white water lily (Nymphæa odorata) and tends to drive out the common pond lily (Nuphar advena).

[11] l. c. p. 50.

Cleome integrifolia Torr. & Gray.—In the Catalogue of the Flora of Minnesota, by Warren Upham, 1884, this species is noted as "an immigrant from the plains west of Minnesota," and is reported only from the southwestern corner of the state. It is a common plant in the neighborhood of White Sand lake, three miles west of Brainerd, where it appears to have been introduced first along the line of the Northern Pacific Railway.

Arenaria patula Michx.—Never before reported from Minnesota. Undoubted specimens of this plant were collected on the north shore of White Sand lake, where, however, it is by no means abundant. The range for A. patula given in the Gray's Manual for 1890, is "S. W. Va. to Ky., Ill., Kan. and southward." Its presence, therefore, in Cass county, Minnesota, is somewhat remarkable. It does not have the appearance of a recent introduction.

Erodium cicutarium L'Her. — Introduced, infrequent. Reported hitherto only from Minneapolis, but found growing rather abundantly along Brainerd roadsides and in ill-kept dooryards.

Ceanothus ovatus Desf.—Hitherto noted only in southern and southeastern Minnesota. Very abundant in the pine barrens north of Brainerd. C. Americanus, noted by Upham as abundant in the upper Mississippi valley, was not seen by us on this trip.

Lespedeza capitata Michx.—Noted by Upham as "extending north at least to Cass county." Very common around Gull lake; noticed on all sides, but more abundant on the southeast shore.

Myriophyllum ambiguum Nutt., var. *limosum* Torr.—This plant is new to the Minnesota flora. It was found rooting in the mud about Irving Chase lake, Cass county, and near the water line of other contiguous forest lakes. The plants collected by us all varied from the type of the variety as described by Torrey, in that, so far as observed, the leaves were pinnately divided into about six or seven very small succulent leaflets. No leaves were seen which could be called either "linear, incised, toothed or entire." Otherwise the correspondence was exact and the Irving Chase lake plants are probably but a local variation. The var. *capillaceum* Torr. & Gray, was not seen.

Liatris scariosa Willd., *L. cylindracea* Michx., and *L. pycnostachya* Michx.—In the Upham catalogue L. scariosa is noted as the "most abundant species southwestward." On the prairies south of the Minnesota river between New

Ulm and Granite Falls, however, it is apparently less common than L. pycnostachya, while in the vicinity of Gull lake and Brainerd it is exceedingly abundant in the pine barrens where L. pycnostachya is rare. L. cylindracea occurs near Brainerd, but only two typical plants were found. In this region almost every individual of L. cylindracea presents a most remarkable divergence from the type and it seems probable that this pine-barren form is of varietal rank. In accordance with such belief I present the following description:

Liatris cylindracea Michx., var. SOLITARIA (n. v.).—Differs from the type of the species in having a bushy stem 6 to 12 inches high, heads somewhat larger, never spiked, but solitary, terminal, erect or nodding.

This remarkable form of L. cylindracea has much more the aspect of a pink than of a blazing star. It has been seen by us only in the pine-barrens around Brainerd. In the Upham catalogue I find this note under L. scariosa: "A remarkable form of this species bearing the heads at the end of leafy ascending branches has been found in a bog near Mankato, by Mr. Leiberg." This may refer to the form just described, but probably does not, for the mucronate involucral scales of L. cylindracea would scarcely permit of confounding it with L. scariosa.

Grindelia squarrosa Duval.—Hitherto reported only from the southwestern edge of the state. Found at Brainerd in the pine-barrens. This plant is evidently traveling eastward at a rapid rate. It is remarkable to find it in the heart of the Minnesota forest.

Hieracium venosum L.—Reported so far only from the prairie region of the Red River valley, but abundant in the pine-barrens about Brainerd and in damp forest opening near Gull lake.

Monotropa Hypopitys L.—Mentioned in the Upham catalogue only from the region north of Lake Superior and from the Dalles of the St. Croix. It occurs rather abundantly in the white pine forests about Irving Chase lake. M. uniflora was not seen.

Plantago Rugelii Decaisne.—Very abundant in a bog near the Brainerd cemetery.

Utricularia gibba L.—Never before reported from Minn. Found growing in the mud at the waters' edge in Irving Chase lake. A foot or two from shore U. intermedia was noted. Both species were smaller than the average, and the peduncles were commonly but one-flowered.

Gerardia purpurea L., var. *paupercula* Gray.—This very variable species was abundant in the grassy beach of Irving Chase lake where it occurred together with Lobelia Kalmii and L. syphilitica. The Gerardia presented constantly an unusually colored corolla. The general hue was light rose purple, but the interior of the upper lip was blotched with dark crimson and orange, while both lips were slightly bearded.

Spiranthes Romanzoffiana Chamisso.—A rare plant in Minnesota. Found in a Brainerd bog, associated with Habenaria hyperborea, Chelone glabra and Campanula aparinoides.

A great variety of sedges was noted in the forest-lake region west of Gull lake. Almost every pond has some form growing abundantly along its shores which is sparingly represented at neighboring ponds or entirely absent. Of these, however, the study is incomplete as yet.

Minneapolis, Minn.

Station botanists at Champaign.

BYRON D. HALSTED, SECRETARY.

The station botanists were not out in full force at the Champaign meeting of the Association of Agricultural Colleges and Experiment Stations, but there was no lack of subjects to consider or topics to discuss; in fact, the time assigned to the meetings of the section was all too short, and some of the papers sent were unread and several others passed without the discussion that otherwise would have followed. It may be said in passing, that the sections made their lack of time known and as a result another full day for the station workers has been added to the next annual meeting. This will relieve matters greatly and make these meetings more than ever valuable to the station botanists.

Dr. J. C. Arthur was the first upon the programme with a paper upon "Reference books, how to use and obtain them." The importance of looking up any proposed subject for investigation was emphasized, for it often happens that a point thought to be new is in reality an old one. In preparing a bulletin it is sometimes best to treat it historically, the citations being given in small type foot notes. These notes, while they occupy small space and do not inconvenience the general reader, are of great service to all who desire to pur-

sue the subject further, while they in fact, give weight to what is printed above, even to the cursory reader.

As to methods of obtaining books of reference it was thought best to buy for the most part, and rely upon borrowing only when other sources fail. To obtain the books second-hand catalogues should be resorted to. It was suggested that the books of each of the station and agricultural college libraries be listed and a catalogue put into the hands of all station workers.

Dr. Arthur at another time in the sessions spoke at some length concerning the exhibition that botanists might make at the coming world's (Columbian) fair, and all were glad to obtain the suggestions that the remarks developed.

The second paper was presented by Prof. G. F. Atkinson, of Alabama, upon "Anthracnose of the cotton," now quite destructive in the southern states. It was first observed by Professor Atkinson upon the leaf scars of the cotton plant, but afterwards upon the bolls.

By means of ink sketches and blackboard drawings the species of Colletotrichum, new and recently named by Miss Southworth C. gossypinæ, was fully illustrated in its structure and habits of growth. The fungus grew readily in solid cultures and was propagated with ease upon the cotyledons of seedling cotton plants. It was suggested that in many other cases inoculations might have possibly been successful had the tender cotyledons been employed in place of the more firm tissue of leaf or stem.

The same speaker presented the case of the black rust of the cotton, which is a miserable trouble due to more than one fungus. The ultimate blackness of the "rust," so called, is largely due to a Macrosporium or Alternaria, or both combined, which follow usually upon the spots that have suffered from a Cercospora. This is another case where a Macrosporium and its allies, not seeming to be able to make the primary attack, can thrive upon and spread from a spot weakened by a genuine fungus parasite. There is a "red rust," so called in North Carolina, that, while doing injury to the cotton, does not seem to be due to any infesting fungus.

One of the most profitable hours of the sessions was that devoted to the inspection of the department of botany in the university under the charge of its genial and wise chief, Dr. Burrill, who has been so long identified with the institution as to hold the well-merited position of senior professor. The herbaria, collections, library, general and special work-

rooms for students, all were full of interest, but the visitors lingered with greatest delight in that portion of the department devoted to the study of bacteria. It was a pleasure to see where many results in bacteriological science had been reached and have the methods pointed out and the apparatus, largely made at the doctor's suggestion, exhibited by a veteran in this obscure and difficult branch of practical botanical science.

Dr. Thaxter, of the Connecticut station, presented a paper accompanied with many specimens of a form of potato scab. The surface of the badly affected potatoes becomes filled with holes, and in these and upon their borders is a grayish filamentous growth due to a fungus. This fungus has been grown upon solid cultures, when it blackens the matrix and develops a lichenoid growth upon its surface. While behaving in some respects like a bacterium its structure does not permit its classification so low in the scale. Among the most interesting specimens shown were potatoes that had been inoculated with the fungus and the scab had developed in the lines touched by the virus, which lines produced in some cases the monogram of the name of the discoverer. The practical point of most interest now remaining is to determine the relation which the same fungus found upon manure bears to the scab of the tubers. It is likely that the trouble is associated with manure and similar decaying substances in the soil, and if so care must be taken in fertilizing the soil for the potato crop.

"Some new diseases" was the subject of Professor Pammel's paper, and it consisted largely of an extended list of injurious fungi as found by him during the present season at Ames, Iowa. Several species were treated at some length, such as the scab of the plum, which may be a new species. The various crops were mentioned with the most injurious diseases attending each. A Cystopus found upon garden beets and several other similar "finds" were reported.

While the above paper was being discussed Assistant Secretary Willits, of the U. S. Department of Agriculture, called upon the section and gave an interesting account of the botanical work being done under his charge. Men were being sent to various parts of this country and to other lands to obtain the desired information to battle against destructive agencies or to increase the much needed knowledge of our native flora. He believed in doing thorough scientific work, but with a keen eye to the practical side, so that immediate good to the farmers might result. The importance of botan-

ical work in the stations was emphasized, and he hoped to be able to assist the station botanists more and more.

Chairman Tracy assured the secretary that the warmest sympathy existed between the station botanists and the Department at Washington and stated that a great impetus had been given to botanical science in this country within the past few years.

"Fungicides" was the subject of a paper by D. G. Fairchild, of the Division of Vegetable Pathology at Washington. A history of the subject was followed by a classification of the large number of different substances employed as fungicides. The theory of fungicidal action was explained and many mixtures were named that had proved effective, and several others were shown that combined the good qualities of a fungicide, namely, effectiveness, ease of application and cheapness. These latter will be tested the coming year, and as some of them are low priced, made adhesive by the addition of molasses, and contain the required ingredients much may be expected for them.

Mr. W. B. Alwood, of West Virginia, treated of "Copper salts for the black rot." Being dissatisfied with the Bordeaux mixture he made a test of various compounds, the following proving effective: Two pounds of sulphate of copper, two and a half of lime mixed while hot, to which five gallons of water was added. Eau celeste without the ammonia also proved a satisfactory fungicide. The second part of Mr. Alwood's paper was devoted to fungicide apparatus. Many drawings were shown to illustrate the aquapult and isolateur forms of pumps. The former are best for heavy pumps and the latter for knapsack sprayers. A universal size for nozzle, screw and other fittings was recommended, and a joint committee of one member from each of the following sections, namely, botany, entomology and horticulture, was formed to consider the whole matter of uniformity of size of parts in spraying apparatus.

Dr. Thaxter exhibited a home-made spraying syringe of small cost at the close of the last session.

Professor Beal discussed "Co-operation in bulletins" and showed that much of the information obtained at one station was of equal value in other if not all states. At present a bulletin circulates only in a single state, and steps should be taken by which they may become more national. This sort of co-operation can not but lead to good results.

The subject of "Weed killing in the prairie states" was chosen by Professor Keffer, of South Dakota, who showed

that his state was peculiarly well adapted for the rapid spread of weeds by winds, live stock and the lack of diversified crops. Among the leading weeds are the mustards, wild rose, golden rods and Salsola Kali. The present weed law is of no avail and the hope lies in a better style of farming.

Mr. G. McCarthy, of North Carolina, considered "Seed testing and its value," and showed the importance of this work and need of co-operation. Uniform apparatus and a standard method are much to be desired.

Dr. George Vasey, of the department of agriculture, presented a paper upon grasses for arid regions which was an outline of experiments now three years in progress at Garden City, Kansas. In 1888 the experiments were started in a small way, with sods of native grasses transplanted to plowed plots. The following year larger areas and a greater variety of grasses and other forage plants were employed. Sorghums also were sown extensively. During the present season the tests have been made on a still larger scale, and while the rainfall has been much below the average the discouragement attending this has been compensated for in part by the results obtained with winter rye. Thus seventeen bushels of grain per acre were obtained during the drought, showing that the yield would have been much greater in an average season.

The following are some of the conclusions that may be drawn from the experiments: Broad leaved annuals that grow quickly, like the sorghums, may do well in an average season, but the broad leaved perennials are not valuable; grasses with strong deep roots or with bulbous bases, or both, are well adapted to an arid region. The best grasses for dry localities must be sought among the natives of such arid places. The following are some of the species particularly well adapted to our arid regions: Panicum virgatum, P. bulbosum, Setaria caudata, Andropogon scoparius, Phalaris intermedia, and several of the Boutelouas.

The secretary treated of the subject-matter of the farmer's bulletin, recommending that it be science in simple form applied to the needs of the crop-grower. The bulletin can often be made much more attractive by better press work and the use of engravings. To publish much technical science in the general bulletin both burdens the farmer and the man of science. The strictly scientific matters, as descriptions of new species, etc., that have no practical bearing to the farmer, had best be published in journals designed

for such purposes. The issuing of technical bulletins by the stations was discouraged as there are well established avenues for the publication of scientific matter in a way that all libraries, societies and interested individuals can find ready access to it.

As officers for the coming year the following were elected: For chairman, Byron D. Halsted; for secretary, Dr. Roland Thaxter.

BRIEFER ARTICLES.

Note on the nomenclature of Uncinula spiralis B. & C.—Burrill and Earle, in their Parasitic Fungi of Illinois, Part II, p. 406, have described this species under the name *Uncinula ampelopsidis* Pk., giving *U. Americana* Pk. (1872), *U. spiralis* B. & C. (1876), and *U. subfusca* B. & C. (1876) as synonyms in the order named. These authors evidently overlooked the fact that as long ago as 1857 Berkeley, in his Introduction to Cryptogamic Botany (p. 278, fig. 64), figured two appendages and a six spored ascus of what is undoubtedly this fungus, giving below the figure the name *Uncinula spiralis* Berkeley & Curtiss. There seems to be no good reason why we should not accept this name which is adopted by Farlow & Seymour in their Provisional Host Index. As the scope of the latter work forbids explanations we thought the present one might not be out of place. Accepting Berkeley and Curtiss' name, we have for the species, then, the following synonymy:

UNCINULA SPIRALIS B. & C., Introduction to Cryptogamic Botany, p. 278, fig. 64, 1857.

U. ampelopsidis Pk., Trans. Albany Inst., Vol. VII, p. 216, 1872.

U. Americana Howe, Erysiphei of the United States, Journal of Botany, 1872.

U. subfusca B. & C., Grev. IV. p. 160, 1876.—B. T. GALLOWAY, *Washington, D. C.*

OPEN LETTERS.

On priority of place in biological nomenclature.

The publication of my note in the October *Journal of Botany* giving my reasons for taking up the generic name *Tissa* instead of *Buda* for the plants referred by recent authors to *Lepigonum* or *Spergularia*, and the comments thereon by the learned editor, have put my position on this question squarely on record. I was sorry to have to take the means I did in order to induce him to print my communication, but I desired that my views should be given place in an English botanical journal as well as in those of America. Mr. Britten, regarding my reasons as trivial,

was justified, from his own stand-point for declining to award them space in the *Journal*, and his refusal, at first, to publish them has in no way diminished my regard for him.

But I do not believe that my reasons will be considered ridiculous by others who approach the topic from a different stand-point, and who have recognized the necessity of adopting methods of procedure which will render the system of nomenclature stable, which is all the "neo-American school" is trying to accomplish and for which it, and all naturalists, have abundant authority. It is perfectly clear that as long as we allow ourselves a choice of names in any way, so long will authors differ in their acceptance and the settling of this important matter be deferred. That this end can be, at least approximately, reached by priority, has been the judgment of most recent naturalists. Whether some entirely different method may not commend itself to those of future decades or some radical modification of the principles now employed be resorted to, it is at present impossible to surmise. It is, perhaps, not unlikely that some such move will be made. The American Ornithologists Union settled it so far as they were concerned, by driving bird names back as far as they could, and then as a body adopted the results thus reached, so that they have been maintained for a considerable number of years. This process has commended itself to some others, but has not been put into operation elsewhere, so far as I am informed.

At all events, under the present methods of botanists it is important that all possibility of choice be removed as far as this is possible. For this reason I regard the "law" of the Paris Congress cited by Mr. Britten as authority for the use of *Buda* rather than *Tissa* as unfortunate and detrimental, and do not consider myself at all bound to follow it.

The number of cases in which change is desirable by reason of priority of place is not great. Mr. Britten cites the one of *Amygdalus* Linn. and *Prunus* Linn., the first standing on a page preceding the position of the second, and pointing out that he thinks it would be necessary to call all the species now in *Prunus, Amygdali.* It certainly would be strange for a while to make this substitution, but I think he has selected an unfortunate example in support of his argument. While it would probably be quite as philosophical to call a plum a peach, as a peach a plum, I personally prefer to call a peach a peach, and am prepared to maintain that *Amygdalus* and *Prunus* are distinct genera. N. L. BRITTON.

Columbia College, N. Y. City.

"Biology" again.

Your July and September editorials which admirably voiced my own sentiments which had been "struggling for utterance," and the reply in the October number have so much interested me that I am overtempted to add a word.

Whether progressive zoölogists have become ashamed of the word "zoölogy" or not, they have precisely the same reason for such a feeling as have we for shrinking from "botany;" and we have precisely the same reason for claiming to teach "biology" as they. Your correspondent, who writes in the October number, misses the real point entirely If he could claim that all biological principles can be deduced from the facts of zoölogy, he might, indeed, then say, "Why should not he claim the word biology?" Otherwise, even though the biological study of plants were not yet begun, his claim is wholly unfounded. Though it be true

that, so far as real biological teaching in this country is concerned, the zoölogists were the pioneers, is it less to the credit of American botanists that they could escape from the old traditions and recognize the vivifying influence of the new ideas? It is true, perhaps, that American botanists have hardly yet recognized the full applicability of what are called "zoölogical methods" to the solution of many of their own problems; but is that any reason why zoölogists should calmly assume that all the necessary data for biological generalizations are to be derived from animal sources? May it not be suggested to the (animal) "biologist" who does condescend to demonstrate to his class the streaming of protoplasm in Nitella or karyokinesis in the root-tip of an onion, that this slight recognition of the superiority of vegetable tissues for the study of vital phenomena might well be carried much further if he but knew it.

That there are many colleges where botany is a mere species-grind, we all know too well, but, is our "prominent zoölogist" so guileless as to imagine that there is none of the quality of a boomerang in such a statement? If so, I beg to assure him that there are colleges of repute, yes, and "universities," where botany is well taught, while the zoölogy is a round of counting scales or tail-feathers; and there are still others where, as between the two, the choice is that of "the devil or the deep sea."

The GAZETTE'S complaint is a very timely and just one. I have heard one of the leaders of American zoölogy remark upon this very condition of things to the effect that he could not understand why botanists remain silent while chairs of biology are repeatedly filled with zoölogists pure and simple, whose teachings, if not their conceptions, of biology are wholly one-sided And he added, "If I were a botanist, I should be heard from." But, if some one says he can do better by himself and by his students if he confines his work to the animal kingdom, we shall have no quarrel. I believe it is best for the occupant of a chair of biology to be either a zoölogist or a botanist, for the obvious reason that it is best for a man to teach well what he teaches. The wrong thing is that there should be chairs of biology. It is absurd to expect a man to cover the field of modern biology. Yet, in how many institutions where no one would think of expecting one man to teach physics and chemistry or English literature and rhetoric, must one man stagger under that load.

If there is money to employ but one man, make the best of it and see that zoölogy or botany is well taught, but don't delude your students with the idea that they are to become biologists in a term. In the name of common honesty and sound ideas let us "call a spade a spade," and not a subsoil plough.

JAMES ELLIS HUMPHREY.
Amherst, Mass.

Mounting plants.

Some articles in the BOTANICAL GAZETTE of October called attention to establishment of "Biological Surveys," and the editors made some very striking remarks concerning the present stage of our botanical explorations; "that botanists should consider plants as biological problems more than specimens to be catalogued, etc." The great importance of Biological Surveys is only too clear, and although I do not intend to discuss this subject more than has already been done, I should like to call attention to a certain point, which undoubtedly ought to be taken in consideration, and which might form an additional remark to those of the editor's, mentioned above. It is merely in regard to the preservation of our herbaria. The specimens in the herbaria should not only be pre-

served so that they may show the habit of the plant, but also that they may be easily handled for examination. The time is long past when botanists are content with mere examination of the structure of the flower, the fruit, etc. The interior structure of the whole plant is far more important in these days. I do not think it necessary to recall the invaluable researches by Vesque, Radlkofer and several others, who have shown us the anatomical characters of plants. But in the manner in which the herbaria are preserved in our country, the specimens are not to be used for such a purpose. All the specimens in the U. S. National Herbarium in the Department of Agriculture are mounted on sheets in such a manner that the entire specimen has been glued and fastened to the paper. Hence the specimen can not be removed from the paper without being broken, and it is very clear that flowers with large petals and stamens can not be examined. For anatomical studies these specimens have lost the greatest part of their value; the covering of glands or hairs is disturbed by this method; and the stems and leaves can not be removed without being broken into pieces. And how about clusters of small flowers which we might want to examine? These are not at all to be removed. Might it not be time now to make a change in regard to the preservation of specimens? Unfortunately, as I have heard, this manner of preservation has been used in museums where the greatest collections are deposited. The new or rather very old and well-known method, which is to be recommended, is to mount the specimens with glued paper strips, which can easily be taken off so that the plant can be examined freely in the hand, and parts cut off which are wanted for examination. This is the general manner of preservation in Europe, and has been used with great success.

Washington, D, C. THEO. HOLM.

CURRENT LITERATURE.

Minor Notices.

IN *Annals of Botany* (vol. iv. no. 15. Aug. 1890) Dr. F. W. Oliver has given an excellent anatomical study of Sarcodes sanguinea, accompanied by four double plates illustrating anatomical details, and a fifth very large one showing the whole plant with its coloration. Of course any member of the Monotropeæ is worthy of careful study, both on account of habit of growth and affinities. Naturally, interest somewhat centers about the root structures, for the plant proves to be a saprophyte or humus-plant. The roots are everywhere invested in a close-fitting sheath of "fungal-mycelium," well displaying, as in Monotropa, the mycorhiza habit. Probably the most striking statement with regard to root structure is that all lateral roots have an exogenous origin! This habit seems to be in common with Pterospora, and the author considers it a special adaptation (a perpetuated advantageous variation) by which the formation of a wound in the cortex may be avoided, thus making the inner tissues less liable to the entry of the mycorhiza fungus (although Monotropa, with the same mycorhiza habit, has the usual endogenous branching). The stem, leaves, and morphology of the flowers are also considered. The development of the reproductive structures of the embryo sac is similar to that which has been fully described by Strasburger and Koch in the case of Monotropa.

PROFESSOR LESTER F. WARD has an interesting paper on the origin of plane-trees (reprint from *Amer. Nat.* Sept. 1890), being chiefly a discussion, from an American stand-point, of Johann Jankó's recent paper ("Abstammung der Platanen") in Engler's *Botanische Jahrbücher*. Professor Ward considers the genus Platanus the last of a long line of ancestry that was once far more abundant than at present, as is also true of Liquidambar, Liriodendron, Sequoia, and Ginkgo. One of the distinctive links in the chain of evidence in tracing the ancestry of Platanus proves to be the basal lobes of the leaf. The author revises the geological distribution of the fossil species of Platanus as given by Professor Jankó.

THE Proceedings of the National Museum, vol. xiii, contains a list of plants collected in 1889 at Socorro and Clarion Islands of the Pacific by the ornithologist (Mr. Chas. H. Townsend) of the Albatross expedition The islands are southwest from Lower California, and should be of great botanical interest. Mr. Townsend should be commended for securing this botanical material in addition to his regular duties. The flora, as is to be expected, is similar to that of Mexico. The plants were determined by Dr. Geo. Vasey and J. N. Rose, of the Department of Agriculture, the total number of species being 26, 18 of them being found on Socorro and 12 on Clarion, among them 3 new species and a variety.

THE THIRD Contribution from the U. S. National Herbarium (dated Nov. 1, 1890,) contains the results of a study of collections of plants made by Dr. Edward Palmer in 1890 in Lower California and western Mexico, at La Paz, San Pedro Martin Island, Raza Island, Santa Rosalia and Santa Agueda, and Guaymas. The work has been chiefly done by Mr. J. N. Rose, under the direction of Dr. George Vasey. New species are numerous, as is to be expected from such unexplored regions and such a collector. Among the new things from La Paz is a very curious genus of Compositæ, dedicated to John M. Coulter, and called Coulterella. The plate shows it to be a shrubby plant, with usually a solitary flower in the heads, whose achene is permanently enclosed by a 3-winged spongy involucre. About 25 new species are described, including a new Euphorbia by Dr. Millspaugh.

THE FIRST MEMOIR of the second volume of the Torrey Club Memoirs is by Dr. B. D. Halsted, on "reserve food-materials in buds and surrounding parts." There are two plates, and the author states his purpose to be "to consider the structure and reserve food contents of the buds and surrounding parts in some of our trees and shrubs, with occasional reference to nourishing substances as stored in other parts of perennial plants." Particular attention is paid to starch; and it is suggested that spines, in addition to being defensive structures, may also act as food reservoirs.

DR. GEORGE VASEY has just issued the first part of "Grasses of the Southwest," being plates and descriptions of the grasses of the desert region of W. Texas, New Mexico, Arizona, and S. California. It is issued

as Bulletin no. 12 of the U. S. Dept. of Agriculture, Division of Botany, and contains 50 most excellent plates. The drawings have been chiefly done by Mr. W. R. Scholl, who is surely to be highly commended for his work, and in the descriptions the author has been aided by Mr. F. V. Coville. A second part, containing an equal number of plates, is now in preparation. This is undoubtedly the most important work on American grasses that has been undertaken, and it is to be hoped that not only the grasses of the desert region will be so treated, but all North American grasses.

NOTES AND NEWS.

THE BOTANICAL GARDEN at Prague was ruined by the great flood of last September.

DR. J. W. MOLL has been called to the professorship of botany at the University of Groningen.

PINUS Montezumæ, of Mexico, is described and illustrated in *Gardeners' Chronicle* for Oct. 25.

PROFESSOR CONWAY MACMILLAN, of the University of Minnesota, has been appointed botanist of the Geological and Natural History Survey of that State.

DESCRIPTIONS of 55 new North American fungi are published by Messrs. Ellis & Everhart in the Proc. Phila. Acad. The reprint bears the date July 29, 1890.

BOKORNY finds by observations with his iron sulphate process that water travels at the rate of 1 meter per hour in the collenchyma of Rumex longifolius.

HANSGIRG has listed and classified the plants having irritable filaments and stigmas, together with those having periodically opening flowers.—See Bot. Cent., 43, 409.

A REVISED list of the Ustilagineæ of Scotland, prepared by Professor J. W. H. Trail, is given in the October *Scottish Naturalist.* It includes 38 species, distributed under 11 genera.

PROFESSOR JOHN M. HOLZINGER, formerly of the State Normal School of Minnesota, has been appointed one of the assistants in the botanical division of the Department of Agriculture.

MR. JOHN ROBINSON, of Salem, Mass., has sent a curious apple, found by W. Leonard. It is a combination Baldwin and Russet, the former forming the upper half, the latter the lower.

THE FOLLOWING North American plants have been recently illustrated in *Garden and Forest:* Arbutus Menziesii (Oct. 22), Hypericum densiflorum and H. prolificum (Oct. 29), Solidago speciosa (Nov. 19).

MRS. E. G. BRITTON has prepared an index to the *Bulletin of the Torrey Botanical Club,* volumes vii–xvi. The previous volumes were indexed separately. Such indexes are absolutely essential to working botanists.

MR. F. V. COVILLE, of the Department of Agriculture, has been appointed botanist of the biological survey of "Death's Valley," California, under direction of Dr. C. H. Merriam. He has already started for the field, and expects to be absent about six months.

MR. THEO. HOLM, of the U. S. National Museum, would like to secure, for germination, any seeds of North American perennial plants. Seeds of Burmannia, Mayaca and Xyris are particularly desired.

THE Botanical Society of W. Pennsylvania, situated at Pittsburgh, is a very active organization numbering 91 members. The officers for 1890–91 are Prof. J. W. Caldwell, president; Prof. J. G. Ogden, secretary; and Mr. C. C. Mellor, treasurer.

THE ANNUAL REPORT of the State Botanist of New York, for 1889, has just appeared. Mr. Peck describes, with the aid of four plates, 37 new species of fungi. Among them is a new genus of Helvellaceæ dedicated to Professor L. M. Underwood under the name Underwoodia.

DR. BYRON D. HALSTED writes in *Popular Science Monthly* (December) of "Prairie flowers in late autumn." The material for such a paper was obtained while the author was botanist at the Iowa Agricultural College.

THE EDITOR of the *Scottish Naturalist*, Professor J. W. H. Trail, resigned his position with the October number, and Mr. W. Eagle Clark, an ornithologist of Edinburgh, will hereafter conduct the magazine. Professor Trail has consented, however, to edit the botanical articles.

MR. ERWIN F. SMITH has made good progress in his investigations of peach yellows, and among other important results has demonstrated by numerous experiments that the disease can be conveyed to a healthy tree by budding. The results of his recent studies will be ready for publication in a short time.

IN HIS fifth contribution to the life histories of plants (reprinted from Proc. Philad. Acad. Sci., Aug. 26, 1890), Mr. Thomas Meehan speaks of the following subjects: anthers of Lappa major; pollination of Crucianella stylosa; unisexuality in connection with the order of flowering in willows; varying character of dichogamy in flowers of Corylus Avellana; dicœcism in Labiatæ; self-fertilizing flowers; male and hermaphrodite flowers of Æsculus parviflora; direction of the spiral twist in the leaves of the Norway spruce.

M. HENRI JUMELLE has determined the effect of anæsthetics upon the transpiration of plants. He finds that a dose which will arrest or diminish assimilation in an illuminated plant increases the transpiration of the leaves over the normal; whereas in darkness ether diminished the transpiration. He explains that this discrepancy is due to the action of the ether on the chlorophyll bodies themselves. Normally part of the radiant energy absorbed by the chlorophyll bodies is used to decompose CO_2, and part to evaporate water from the chlorophyll bodies. When anæsthetized, however, all the energy is used in producing cholophylline transpiration.—Cf. *Rev. gén. de Bot.* 2, 417.

IT MAY now be considered as a well-established fact that vegetation exerts a definite and easily demonstrable drainage action on the soil. Ebermayer's earlier researches have shown that more water penetrates the soil of shaded regions than into that of naked fields. By some recent researches he shows that while the surface portions of the soil in a forest is moister than open fields, this is not true of the deeper parts within the range of the roots of the trees, for this is distinctly drier. For example: at a depth of 45–50 cm. in a fir forest of 60-year-old trees the percentage of water by weight is 15.12 as against 19.89 in naked soil. He has also determined that in soil covered with young trees (6 years old), the loss of water by transpiration is intermediate between that from soil covered by mosses and that covered by grass.

ROSOLL has carefully determined a large number of microchemical methods for the recognition of glucosides and alkaloids. These will be found summarized in a recent paper printed in the 25th *Jahresbericht des niederöster. Landes Real-Gymnasiums Stockerau*, unfortunately a very inaccessible publication.

ALLUSION was made in this journal (xv, p. 188) to the preliminary paper by Dr. Blass, in which he denied that the function of the sieve-tubes was the transport of proteids. He has now published his experiments *in extenso* (Prings. Jahrb. 21, 253–292.). As, according to Heine, the function of the starch sheath is to provide for the formation of the bast, so B. thinks the true function of the sieve-tubes is to provide nourishment for the construction of the xylem. The fact that the sieve-tubes and vessels appear simultaneously in the youngest parts of plants, as well as the fact that the sieve-tubes show their typical form only in plants with true wood, points to reciprocal relations. Furthermore the structure and contents of the phloem are such as to indicate a provision for storage and radial conduction of proteid materials in the immediate vicinity of the cambium.

WORTMANN has just published an important paper (in the *Bot. Zeit.*, 48, 581, et seqq.) on the recognition, occurrence and significance of diastatic ferments in plants. The present view, that starch is always brought into solution by the agency of diastase, is erroneous, he says. Diastase is either not present at all, or not in sufficient amounts, in the assimilating parts of plants to account for the solution of the starch. On the other hand it is found in small quantities (as large, however, as in assimilating organs) in starch-free seeds, tubers and roots. W. concludes that diastase is a direct derivative of protoplasm, sometimes occurring in small quantities, sometimes in large. His experiments go to show that in many cases protoplasm itself brings about the solution of starch. There is really a very short step between the cases of such direct action, and those in which the protoplasm produces diastase in sufficient quantities to effect solution. When we consider the quantitative and temperature relations of the diastatic enzymes it is evident that they ally themselves more closely with vital than with chemical substances. The observations and conclusions of W. harmonize well with the investigations of Krabbe (see this journal xv, p. 279) on the mode of solution of starch grains by diastase and with Haberlandt's studies on the diastase secreting function of the "aleurone-layer" in the seeds of grasses.

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